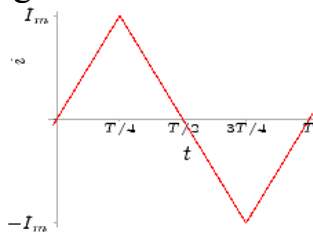


## V. Theoretical questions

1. Define electric current passing through the conductor cross-section. What is its unit?
2. Define electric voltage between two points in electric field. What is its unit?
3. Explain the difference between electric device and its model (i.e. electric circuit). State the basic classification of time functions from the point of view of the magnitude and time variation.
4. Describe the first Kirchhoff's law for electric circuits and give an example of its application.
5. Describe the second Kirchhoff's law for electric circuits and give an example of its application.
6. Formulate the Ohm's law for resistive two-terminal. State the relation for computation of constant cross-section conductor resistance. Define the unit of the resistance. Express the Ohm's law of the resistive two-terminal and state the equation for computation of the resistance of conductor with constant cross section. Define the resistance unit.
7. Define the instantaneous power of arbitrary two-terminal and state its representation by means of voltage and current. State representation of the power of the resistive circuits by means of resistance and just voltage or current.
8. Define the periodic time function of voltage and current and state equation for computation of mean value within a period.
9. State the equations for computation of mean value of the voltage and mean value of the current.
10. Define the root mean square value of voltage and current periodic time function and state equation for its computation.
11. Compute mean value and root mean square value of sinusoidal current of the amplitude  $I_m$ .
12. Compute mean value and root mean square value of rectangular current of the amplitude  $I_m$ .
13. Compute mean value of alternating symmetrical sawtooth waveform current of the amplitude  $I_m$ .
14. Describe basic active elements of electrical circuits.
15. Describe basic passive elements of electrical circuits.
16. Draw the circuit models of actual linear electrical energy sources and state its loading characteristics.

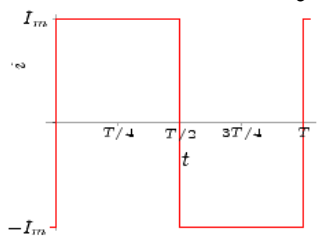
17. Compute waveform of voltage across linear inductor with inductance  $L$  if the passing current is  $i(t) = I_m \sin(\omega t + \varphi)$ .

18. Compute and draw waveform of voltage across linear inductor with inductance  $L$  if the passing current has sawtooth waveform according to the figure

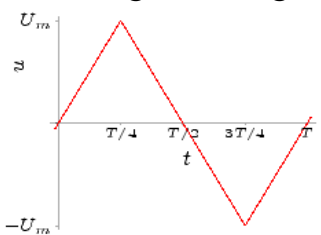


19. Compute voltage waveform across linear capacitor with capacitance  $C$ , if the passing current is  $i(t) = I_m \sin(\omega t + \varphi)$  and initial voltage was  $u_c(0)$ .

20. Compute and draw waveform of voltage across linear capacitor with capacitance  $C$  passing by rectangular current according to the figure and initial voltage was  $u_c(0)$



21. Compute and draw waveform of current passing through linear inductor with inductance  $L$  if the voltage across inductor has sawtooth waveform according to the figure and initial current was  $i_L(0)$



22. State equations for computation of resistance of series connection and parallel connection of  $n$  resistors. Find resistance of series connection and parallel connection of two resistors with resistances  $R_1$  and  $R_2$ .

23. State equations for computation of capacitance of series connection and parallel connection of  $n$  capacitors. Find result capacitance of series connection and parallel connection of two capacitors with capacitances  $C_1$  and  $C_2$ .

24. State equations for computation of inductance of series connection and parallel connection of  $n$  inductors without mutual coupling. Find inductance

of series connection and parallel connection of two inductors with inductances  $L_1$  and  $L_2$ .

25. Draw the circuit diagram of voltage divider which contains two resistors  $R_1$  and  $R_2$  and derive equations for computation of its open-circuited voltage.
26. Draw the circuit diagram of the current divider which contains two resistors  $R_1$  and  $R_2$  and derive equations for computation of the currents.
27. Draw the star connection of three resistors and the equivalent delta connection. Derive equations for computation of equivalent delta connection resistances.
28. Draw the delta connection of three resistors and the equivalent star connection. Derive equations for computation of equivalent star connection resistances.
29. Draw the Thévenin's equivalent circuit and Norton's equivalent circuit of the active linear resistive two-terminal. How the parameters could be computed?
30. Demonstrate on the example usage of the step by step simplification method in analysis of elementary linear resistive circuits
31. What is the superposition theorem in the electrical circuits? Demonstrate on the example its application in linear resistive circuit analysis.
32. What is the value of the load resistor  $R_s$ , which is connected to the voltage source with internal voltage  $U_i$  and internal resistance  $R_i$  to achieve maximum power of the load  $R_s$ ? Compute maximum load power, which could be delivered from the source and the efficiency in this case.
33. Define the phasors of sinusoidal voltage  $u(t) = U_m \sin(\omega t + \varphi)$  both in the scale of amplitudes and effective values. Write formulas for inverse transform of phasors  $\mathbf{U}_m$  and  $\mathbf{U}$  into the time domain (i.e. transform associating the corresponding time function to the phasors).
34. Write the linearity property of phasor transformation. Write the phasor of a differentiated sinusoidal variable and the phasor of an integrated sinusoidal variable.
35. Describe the relations between the time functions of voltages and currents for basic passive two-terminals in the sinusoidal steady state. Sketch these relations between voltages and currents.
36. Describe the relations between the phasors of voltages and currents for basic passive two-terminals in the sinusoidal steady state. Sketch the phasors of voltages and currents.

37. Define the impedance and admittance of a general linear passive two-terminal and write its notation both in the standard form and the polar form.
38. Write both in the standard form and the polar form admittance of two-terminal, if its impedance is  $\mathbf{Z} = R + jX$ .
39. Write both in the standard form and the polar form impedance of two-terminal, if its admittance is  $\mathbf{Y} = G + jB$ .
40. Derive formulas for computation of the resultant impedance of series connection of  $n$  linear passive two-terminals that have impedances  $\mathbf{Z}_k = R_k + jX_k$ .
41. Derive formulas for computation of the resultant admittance of parallel connection of  $n$  linear passive two-terminals that have admittances  $\mathbf{Y}_k = G_k + jB_k$ .
42. Find resultant impedance of series connection of two two-terminals with impedances  $\mathbf{Z}_1 = Z_1 e^{j\varphi_1}$  and  $\mathbf{Z}_2 = Z_2 e^{j\varphi_2}$  (result write in the polar form).
43. Find resultant impedance of parallel connection of two two-terminals with impedances  $\mathbf{Z}_1 = Z_1 e^{j\varphi_1}$  and  $\mathbf{Z}_2 = Z_2 e^{j\varphi_2}$  (result write in the polar form).
44. Find resultant admittance of series connection of two two-terminals with admittances  $\mathbf{Y}_1 = Y_1 e^{j\psi_1}$  and  $\mathbf{Y}_2 = Y_2 e^{j\psi_2}$  (result write in the polar form).
45. Find resultant admittance of parallel connection of two two-terminals with admittances  $\mathbf{Y}_1 = Y_1 e^{j\psi_1}$  and  $\mathbf{Y}_2 = Y_2 e^{j\psi_2}$  (result write in the polar form).
46. Define the term voltage transfer function for the linear circuit, where the input (exciting) voltage is  $u_1(t) = U_{1m} \sin(\omega t + \varphi_1)$  and output (excited) voltage is  $u_2(t) = U_{2m} \sin(\omega t + \varphi_1)$ .
47. Write the Thévenin's theorem and Norton's theorem for linear active two-terminals in sinusoidal steady state.
48. Describe procedures and rules for sketching of phasor diagrams of linear circuits in sinusoidal steady state.
49. Define active power of two-terminal in sinusoidal steady state and derive formula for its computation.
50. Define reactive power of two-terminal in sinusoidal steady state and derive formula for its computation.
51. Define apparent power of two-terminal in sinusoidal steady state and write the relation among apparent, active and reactive power.

52. Define the power factor for sinusoidal current and write the relation for its computation in sinusoidal steady state. How is possible to find the power factor by means of measured active power and reactive power?
53. Write the formulas for computation of active, reactive and apparent power of two-terminal, if its the voltage and current are expressed by the means of phasors.
54. Define symmetrical three-phase voltage system which consists of voltages  $u_R, u_S, u_T$  and describe it using both time functions and phasors.
55. Explain the term phase sequence. How the behavior of some electric devices will change when the phase sequence will be changed? Describe, how is possible to check the phase sequence by the means of measuring.
56. Draw star connection of symmetrical three-phase voltage sources. Draw corresponding topographic phasor diagram, showing both phase voltages and line-to-line voltages. What are the relations among phase voltages and line-to-line voltages?
57. Symmetrical three-phase voltage source in star connection supply asymmetrical star connected three-phase load which contains three two-terminals of different impedances. The nodes N and 0 are interconnected by the neutral wire. Draw the mentioned connection and evaluate generally phasor of the current  $I_0$  passing through the neutral wire.
58. Symmetrical three-phase voltage source in star connection supply asymmetrical star connected three-phase load which contains three two-terminals of different impedances. The nodes N and 0 are not interconnected by the neutral wire. Draw the mentioned connection and evaluate generally phasor of voltage  $U_0$  across the 0 node of the load and N node of the source.
59. Symmetrical three-phase voltage source in delta connection supply asymmetrical delta connected three-phase load which contains three two-terminals of different impedances. Draw the mentioned connection and evaluate generally phasors of line currents  $I_R, I_S, I_T$  as relations among line voltages and load impedances.
60. What are formulas for computation of the active, reactive and apparent power in symmetrical three-phase circuits?
61. Symmetrical three-phase voltage source in star connection is loaded by asymmetrical star connected three-phase load which contains three two-terminals of different impedances. The nodes N and 0 are not interconnected by the neutral wire. Draw the mentioned connection. What are general formulas for computation of active, reactive and apparent power?

62. Symmetrical three-phase voltage source in delta connection is loaded by asymmetrical delta connected three-phase load which contains three two-terminals of different impedances. Draw the mentioned connection. What are general formulas for computation of active, reactive and apparent power?
63. Two inductors are mutual coupled by some common magnetic flux. The inductors are in sinusoidal steady state. Write the formulas for computation of voltage phasors across inductors as function of currents passing the inductors.
64. Two inductors are mutual coupled by some common magnetic flux. The inductors are in sinusoidal steady state. Write the formulas for computation of current phasors passing the inductors as function of voltages across the inductors.
65. Draw and describe basic types of ideal linear controlled sources. What is the model of the actual linear controlled source?